REPORT OF

# ELEVENTH ANNUAL
# Date Growers' Institute

HELD IN

## COACHELLA VALLEY

CALIFORNIA

APRIL 20 and 21, 1934

Held under the auspices of and published by
Coachella Valley Farm Center

# Eleventh Annual

# Date Growers' Institute

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# DATE GROWERS' FIELD TOUR

## Friday, April 20th, 1934

Present knowledge concerning the nature and spread of decline disease in date palms was discussed by Dr. Donald E. Bliss, Citrus Experiment Station, before a group of 45 people who attended an afternoon field tour in Coachella Valley April 20, 1934. Experiments on the control of this malady were observed in two gardens. An article entitled "Investigations on the cause of decline disease in date palms," which is printed in this Report of the Date Growers' Institute, gives information regarding the topics discussed.

The tour was under the auspices of the University of California Citrus Experiment Station and Agricultural Extension Service.

# Eleventh Annual Date Growers' Institute

## Saturday, April 21st, 1934

## Morning Session

# STABILIZING THE DATE INDUSTRY

**By H. J. Webber, Citrus Experiment Station, Riverside, Calif.**

**Remarks of Chairman in Opening Eleventh Annual Date Institute**

I AM always pleased to act as Chairman of one of the sessions of your annual meeting as it gives me a definite duty to perform and makes my attendance necessary.

The date industry in this section of the United States has now been in process of development since the early days of the present century when the first offshoots of imported varieties were planted in an experimental tract at Mecca. The development has thus been under way for a period of approximately only 30 years. There can be no doubt that the progress made during this period is little short of marvelous. Starting from "scratch" with nothing but a barren and apparently worthless desert area, an outstanding industry has been developed. History has been made, and the names of many pioneer growers and experimenters will be revered by posterity for noteworthy achievement. From sand dunes and desert waste there has been reared homes, gardens, cities, and a civilization of intelligent people.

All noteworthy varieties of dates have been imported. A knowledge of successful methods of culture has been developed. In pushing the industry forward new knowledge and new methods have been developed. In a few short years you have made more advance toward a thorough scientific understanding of all phases of the industry than was made by all the world before, during a period of some 4,000 years. If I am correctly informed this valley has already become the center of information relative to this ancient industry and the most important literature of the industry has originated here. This as I interpret it, is a really great achievement.

I am recalling these facts as a feature of encouragement. You are passing through a very serious depression. Your selling agencies have been hard pushed and perhaps were not so successful as you had reason to expect. Returns for the crop have been too low—ridiculously low, apparently. Discouragement runs riot where confidence should prevail. A prophetic vision and wise management is needed to lead the industry to success. I cannot point out the way. I can only make certain statements that I believe are fundamentally correct.

First, I would insist that the development of date growing into an important industry in the Coachella Valley, is based on sound principles. You are an integral part of the United States, the great country that is recognized by all peoples of the world as the best market for such products. This country is producing only a small fraction of the dates actually consumed and the per capita consumption is still very low. If the duty now placed on the imported product is insufficient to cover the differential in cost of production due to lower cost of labor and lower per acre capital investment in foreign date sections, then the import duty should be raised. That you can produce good yields of high quality fruit has been abundantly demonstrated. That you pick, handle and pack this fruit by more cleanly and hygienic methods is certain. If date growing anywhere is remunerative it should be here. Date growing in my judgment is one of the most promising of any of our numerous agricultural industries.

What then is the reason for the extremely low prices that growers are realizing? You know better than I the explanation of this condition. I have every confidence that under proper conditions the acreage of dates in the United States could be quadrupled and the crop sold at remunerative prices. The question of paramount importance is how? And this is the great problem before you for solution. The problem cannot be solved by bickerings and recriminations. You are all interested in achieving success. The problem is a mutual one and can be solved only

through good will and whole-hearted cooperation.

It appeals to your chairman that a part of the solution may be found by providing for a more direct distribution of a considerable part of your crop at moderate prices but which will cover all costs and leave a fair margin of profit for the grower. Families of unlimited means will always wish to purchase the most carefully selected and packed product and will not question the price, but the great mass of potential consumers will only use dates in quantity when the price is low. Many times I have stopped at roadside sale stands in the valley and found the price in five-pound packages to be from 25 to 50 cents per pound when growers were getting returns of only two to ten cents per pound. I cannot pay for fancy packing. I must watch where the pennies go. I want to purchase good dates in bulk at a price that will give the grower a fair return. I would use some dates at 25 cents per pound but not many. I would use very many more if I could purchase good California dates at 15 or 20 cents per pound. They must be hygienically handled, cleaned and sterilized but I want bulk fruit, not fancy pack.

It seems to me that a few agencies in our main cities could be established of the "drive in" or "cash and carry" type, that could be kept provided with good bulk fruit through regular truck deliveries. Purchasers would soon come to know such places where a supply of dates could be purchased at reasonable prices. In this age of automobiles we go to the place where we can get what we want at a correct price. I am raising the question whether it may not be better for the industry to handle large quantities with small returns rather than small quantities with large returns. By the former method the cost is mainly in production; by the latter method the cost is largely in the packing and sale.

You know all of this, however, better than I. What I want to emphasize is that at present the consumer pays too high and the grower gets too little. Must not the solution be sought primarily in the methods of distribution? Should you not fix a fair price for different standard grades of fruit and all growers uniformly maintain this price? Should you not go further and see to it that the consumer in your main centers of distribution has available a place where your fruit can be purchased at these prices.

The people of our wide spread country do not know that California grows dates. They must be taught. Should not the industry select certain centers for distribution and concentrate on the education of these centers only, gradually extending the territory with the extension of the industry. These are a few of the questions that occur to one not concerned directly with the industry. They are suggestions for your consideration in seeking to stabilize the industry.

# Investigations On the Cause of Decline Disease In Date Palms

**By Donald E. Bliss, Junior Plant Pathologist, Citrus Experiment Station, Riverside, California**

THE diagnosis of decline has often been difficult because the primary cause of this disease was unknown and its symptoms were of a general, non-specific nature which were not easily recognized in their early stages.

In 1933, Bliss (1) described the symptoms of this malady, which included: First, premature death of leaves; second, retardation in growth; third, unfruitfulness; and fourth, necrosis of the roots. Up to that time no characteristic lesions had been recorded. It is the purpose of this paper to report recent investigations on the cause of decline, dealing principally with the nature and origin of root decay.

As reported by Fawcett and Klotz (2), decline disease was first noted in Coachella Valley about 1921. Although confined to a few palms at first, it spread to healthy trees in adjoining rows and to other plantings of the Deglet Noor variety.

About 400 palms in 16 widely separated gardens are now affected, and new instances of the malady are being discovered each year. The decline-diseased areas include most of the common soil types to be found in Coachella Valley and are subject to a relatively wide range of cultural practices. Grapefruit and orange trees interplanted with diseased palms have thus far compared favorably with similar trees in healthy sections of the same gardens. Of the many varieties of dates to be found in and about affected areas, Deglet Noor is peculiar because of its susceptibility. No cases of decline have yet been reported in the Zahidi, Kustawy, Halawy, Tazizaoot, and Iteema varieties, although trees of these varieties are known to be growing in close proximity to the disease.

Chemical soil treatments about decline-diseased palms were initiated in 1929 and continued until 1933, at which time the experiments included 321 trees in six widely separated areas. Seven fungicides and 19 different chemical fertilizers were used in relatively large amounts and the applications repeated one or two times at yearly intervals. Haas and Klotz (3) reported an instance where the application of 50 pounds of copper sulfate to the soil about a diseased palm caused marked improvement in its condition. This treatment has since been repeated many times but with little or no visible effect. None of the other treatments have thus far given uniformly beneficial results, and no definite clues have developed from these experiments as to the cause of decline disease.

Fawcett and Klotz (2) noted as high as 90 per cent of dead roots on some palms which were badly affected with decline. Since little was known regarding the cause of root decay in these trees, the writer set about to study this problem. Specimens from the underground portions of diseased trees were taken to the laboratory and from them many different micro-organisms were isolated in pure culture. The pathogenicity of these organisms was then tested in the greenhouse by introducing cultures into the soil about healthy potted seedlings of date palm. Such

experiments included 206 inoculated and 58 uninoculated (control) pots in which approximately 1,850 seedlings were grown. Some of the fungous species which were tested have been placed tentatively in the following genera: Rhizoctonia, Fusarium, Cephalosporium, Trichoderma, and Omphalia. Up to the present time and under the conditions of these preliminary experiments, Omphalia sp. is the only organism which has proved to be strongly pathogenic on the unwounded, underground portions of seedling date palms.

The first isolation of Omphalia sp. from a tree known to be suffering from decline disease was made November 18, 1931. This fungus, when grown in pure culture on 2 per cent glucose-potato agar, was characterized by its abundant white or hyaline hyphae which contained numerous clamp connections. Although this and cultures isolated from other gardens were sterile when grown on nutrient media in the laboratory, four cultures produced small toadstools on the bases of palms which had been artificially inoculated in the greenhouse. Complete identification of this fungus has not been attempted because sporophores are unknown in nature and those which developed in the greenhouse may not be typical of the species.

Because of the consistent results obtained by the inoculation of date seedlings with the original cultures of Omphalia sp., isolations were made from the roots of palms in other gardens to determine the prevalence of this fungus. Twelve gardens were explored. Specimens from nine healthy trees gave no evidence of Omphalia sp., but this mold was obtained from 19 out of 41 decline-diseased palms, representing 10 of the 12 gardens examined. Cultures obtained from these later isolations resembled those of the first, both in cultural characteristics and in pathogenicity.

Seedling date palms in the two-leaf stage were often killed by Omphalia sp. within 14 days from the time of inoculation. Older plants died after a longer interval or remained alive indefinitely in a more or less stunted condition. Not all of the inoculated plants were attacked. One culture of Omphalia sp. produced lesions on 68 out of 79 potted seedlings of Deglet Noor which were used in 11 different experiments. In similar trials, seedlings of Iteema, Zahidi, Kustawy, Tazizaoot, Halawy, and Khalasa varieties were affected to nearly the same degree as those of Deglet Noor. This result may be explained partially because of the varying genetical composition of seedling date palms which, as a rule, do not resemble their parents.

With potted seedlings, two to 12 months of age, the first visible sign of attack was the wilting (folding) and subsequent death of the leaves. This symptom was due to necrotic lesions on the leaf bases from which the mold was easily reisolated. The roots were also invaded. Definite, necrotic lesions developed within the large, primary roots, while young roots which were just emerging were often killed outright before they reached the soil, being attacked by the fungus as they penetrated the leaf sheathes at the base of the trunk. Fungous invasion followed in the basal portion of the trunk and, in young plants, the meristematic tissue of the terminal bud was affected, causing death to the plant. In larger palms the trunk was usually not affected to a depth of more than one inch and in such cases the trees were not killed.

Three-year-old seedling date palms in the field at the Citrus Experiment Station were exposed to infection by introducing cultures of Omphalia sp. into the soil at their bases. After four months the young trees were taken up for examination. Uninoculated palms were free from disease, while the inoculated ones were all severely affected.

In these experiments the most pronounced symptom was the abortion of the young, primary roots. Some of the trees also bore an unthrifty or stunted appearance. Delicate, branched, rope-like bundles of mycelium, technically known as rhizomorphs, were found along the surface of roots to a distance of 2½ feet from the place of inoculation. Portions of these roots were dead and filled with the mold.

In Coachella Valley, a rooted offshoot of Deglet Noor was examined one year after inoculation with Omphalia sp. No symtoms of disease were as yet evident in the top, but the mold was found in the basal portion of the trunk in eight separate places, causing death or well-defined lesions in the primary roots. In this and the above-mentioned experiments, Omphalia sp. was reisolated from tissues within the cortex of affected roots and often from lesions in the leaf bases.

Further examination of the roots of decline-diseased palms in the field revealed definite, necrotic lesions which were similar to those on plants artificially inoculated with Omphalia sp. In one instance this mold was isolated in pure culture from cortical lesions in 13 out of 14 roots obtained from a naturally infected palm. This tree showed marked symptoms of decline disease.

Omphalia sp. has been isolated not only from the roots of large, decline-diseased palms but from offshoots attached to their bases. In one garden 22 offshoots from decline-diseased trees and 34 offshoots from healthy palms were planted in adjoining rows and at some distance from the affected area. The offshoots in these two lots are said to have been approximately equal in size when planted. After six years, however, the volume in the top of palms derived from healthy parents was about six times greater than that in palms from diseased parents. Furthermore, symptoms of decline had appeared in nearly all members of the latter group and Omphalia sp. was readily isolated from one of them.

In 1928 apparently healthy offshoots of Deglet Noor were planted in a decline area where certain diseased palms had been removed. These plants failed to grow normally, becoming stunted and worthless. One of these palms was removed in 1933 and taken to the laboratory where it was discovered that the basal portion of the trunk, including roots, dead leaf bases, and small offshoots, was badly infected with Omphalia sp. This palm exhibited severe symptoms of decline disease.

**Summary and Discussion**

A fungus, whose fruiting bodies resemble the toadstools of the genus Omphalia, has been found many times in decline-diseased palms, but never in healthy ones. This mold is highly pathogenic on experimental plants, producing lesions in the underground parts which resemble those found on naturally infected palms in the field. Symptoms of decline developed in offshoots from diseased palms within six years after they were planted in healthy soil. Omphalia sp. was isolated from one of these affected trees. Offshoots of Deglet Noor which at first were thought to be healthy, developed symptoms of decline within five years after they were planted in untreated diseased soil where sick palms had been removed. Within the base and roots of one of these palms, many typical lesions were found which contained Omphalia sp.

Because this fungus is apparently responsible for root decay in decline-diseased palms, the lesions which it produces constitute a specific, diag-

nostic character. It should be further noted that such symptoms of disease, as the premature death of leaves, retardation in growth, and unfruitfulness, may be secondary to that of root necrosis. If this is true, Omphalia sp. may be considered the primary cause of decline disease.

### Literature Cited

(1) Bliss, Donald E. Symptoms of decline disease. Date Growers' Institute Rept. 10:10. 1933.

(2) Fawcett, H. S., and L. J. Klotz. Diseases of the date palm, Phoenix dactylifera. California Agr. Exp. Sta. Bul. 522:1-47. 1932.

(3) Haas, A. R. C., and L. J. Klotz. Nutrition and composition of the Deglet Noor palm in relation to the decline disease. Hilgardia 5:511-530. 1931.

# The Relation of Growth and Chemical Composition of Deglet Noor Dates to Water Injury

By Donald E. Bliss and A. R. C. Haas, Citrus Experiment Station, Riverside, California

UNDER the present economic conditions the quality is of more importance than the quantity of fruit produced. One of the chief factors affecting the quality is a physiological disease known as "water injury" which consists of two types:

(1) Checking, which predisposes the fruit to blacknose, and (2) tearing, which exposes the pulp to microorganisms that bring about fermentation and decay.

In order to understand the nature of water injury and its control, studies were made on the growth and chemical composition of fruits at various stages of development. Growth was measured quantitatively as to length, diameter, fresh weight, dry weight, and ash content. Analyses of inorganic and sugar constituents together with the discovery regarding the location of the meristematic tissue in the fruit, form a basis for the study of water injury. The analyses furnish some concept regarding the amounts of the various constituents removed by the fruit and the portion of these amounts wasted as a result of late thinning of the fruit bunches.

Experiments in the field and in the laboratory were designed to study the factors influencing the cause and control of checking and tearing. These experiments have involved the measurement of water loss due to transpiration of the fruits, the effect of time and type of bagging, and of aeration in their relation to water injury and fruit quality. As a result of these studies we have both increased and decreased the amount of water injury as compared to the field run and have suggested a principle which governs water injury. The present paper therefore deals with growth studies, chemical composition, and their relation to water injury in fruit of the Deglet Noor variety.

### Growth

Very little is known regarding the growth of the fruit of monocotyledonous plants. Crawford (2) has reported studies on mean length, breadth, and weight of the flesh and seeds of fresh fruit obtained from the Deglet Noor variety of date palm. The writers measured the growth of Deglet Noor fruit during the years 1932 and 1933. Our measurements of length and breadth were made from the same fruits which remained attached throughout the season. During 1932 the length of 10 fruits and in 1933 both the length and largest diameter of approximately 30 fruits were measured at intervals ranging from 1 to 5 weeks. The season of 1932 was 1 to 2 weeks more advanced than that of 1933. The fruit reached its maximum length about August 12, 1932 and August 30, 1933. The maximum diameter in 1933 also occurred on August 30. Approximately 75 per cent of the growth occurred during June and July.

Quantitative measurements of the growth of one average fruit, as indicated by the fresh and dry weights, and ash content of the pulp (whole fruit without calyx or seed) were obtained at intervals of 3 weeks between May 21 and September 20, 1932, on samples ranging from 300 to 640 fruits each.

Length and fresh weight after reaching a maximum on August 12, fell gradually thereafter as maturation progressed, while the dry weight and ash content showed a gradual but uninterrupted rise throughout the season.

The rate of influx of ash was nearly uniform throughout the entire season, while that of carbohydrates prior to July 22 was distinctly less than that subsequent thereto. It may be significant that the time at which the increased rate of influx of carbohydrates occurs, is nearly coincident with the time at which the maximum length is attained.

The percentage of dry matter in the fruit decreases gradually until about July 1, after which it increases rapidly with increasing age, and consequently the percentages of water in the fruit are largest about July 1, after which they progressively decrease. This turning point in the percentage of water in the fruit is coincident with the greatest rate of growth.

The most significant change in the percentage composition of the fruit during its development was the substitution of carbohydrates for water subsequent to about July 22. The rate of increase in the weight of ash in the pulp (without calyx or seed) of an average fruit is rather uniform throughout the season. The percentages of dry matter in the tip halves exceed those in the stem halves.

For the purpose of studying the nature of growth, ink marks were placed on young fruit on May 20, 1932. It was soon found that the region of most rapid growth was that enclosed by the calyx.

In 1933, similar experiments were conducted on fruit at different times throughout the season. A wide band of india ink of varying width, more or less covering the fruit, was painted along each of 10 to 40 fruits from the attachment of the calyx to the stylar tip. This was repeated on similar lots of fruit on the same bunch at three other times during the season. As growth proceeded the painted epidermis drew away from the calyx, leaving a zone of unpainted tissue. The width was measured at various times and it was evident that the region of greatest growth was that enclosed by the calyx.

### Chemical Composition

Fruit samples consisting of several hundred fruit each were collected near Indio, California, at intervals of three weeks during 1932. The bunches of fruit used were selected for uniformity of age and were obtained from a small group of healthy palms about six years of age.

The lot of fruit prepared on any given date except May 21 was divided into two equal parts and their seed removed. One of these lots supplied the material for the analyses of the whole fruit without calyx or seed, while the fruits in the other lot were cut into stem and tip halves along the equator. The number of fruits, together with the fresh, dry, and ash weights per average fruit, were recorded.

The amount of potassium in the pulp (no calyx or seed) of an average fruit is far in excess of any of the other inorganic constituents. An average fruit contained two or more time as much potassium as total nitrogen, and over 10 times the amount of total phosphorus. The values obtained for sodium closely resemble those for chlorine.

The inorganic constituents in the fruit pulp arrange themselves in three groups. Group I consists of potassium, total nitrogen, total chlorine, and sodium; Group II, calcium, magnesium, total sulfur, and phosphorus; and Group III, iron, copper and manganese.

While the fresh weight of an average fruit reached a maximum on August 12 and decreased thereafter, the amounts of inorganic constituents increased at a more or less constant rate throughout the season, in a manner similar to those of dry weight and ash. The percentages of potassium, sodium, calcium, and total sulfur in the dry matter of the stem half exceed in every case those in the tip half. Calcium and magnesium are present in the ash in approximately equal amounts.

Cleveland and Fellers (1) noted the high percentage of potassium in the ash of fruit pulp of the Halawi and Sayer varieties grown in Iraq. Their results are shown below in comparison with some which we have obtained on samples of six varieties collected at different locations in Coachella Valley, California.

| Variety | Potassium in Ash of Pulp (%) Results of Cleveland and Fellers | Authors' Results |
|---|---|---|
| Deglet Noor | | 43.12 |
| | | 43.26 |
| | | 43.47 |
| | | 43.38 |
| | | 43.79 |
| Halawi | 35.45 | 42.57 |
| | | 43.17 |
| Sayer | 33.87 | |
| Kustawi | | 43.37 |
| Barhi | | 40.90 |
| Khadrawi | | 43.68 |
| Zahidi | | 42.09 |

It is seen that our results are consistently higher than those obtained by Cleveland and Fellers (1). This may indicate that the ash of the dates of the Coachella Valley may be richer in potassium than the ash of dates from Iraq.

The following data give the amounts (in pounds) of nitrogen, phosphorus, and potassium in the seed-free pulp of the fruits of an average palm at different stages of development, assuming that only 9,000 fruits are present throughout the season (based on analyses for 1932). These amounts are in addition to those required by the other parts of the palms, such as leaves, trunk, and roots.

| Date | N | P | K |
|---|---|---|---|
| | pounds | pounds | pounds |
| May 21 | 0.0213 | | 0.0378 |
| June 10 | 0.1111 | 0.0160 | 0.2070 |
| July 1 | 0.1841 | 0.0330 | 0.3555 |
| July 22 | 0.2233 | 0.0394 | 0.4617 |
| August 12 | 0.3287 | 0.0589 | 0.6650 |
| September 2 | 0.4105 | 0.0696 | 1.0510 |
| September 20 | 0.5280 | 0.0903 | 1.2940 |

It is seen that the amount of potassium in an average crop agrees with that calculated by Haas and Klotz (3) who obtained the value of 1.5 pounds per palm per year. Palms of the Deglet Noor variety often set several times as many fruits as they can mature in a desirable grade, so that thinning of the bunches becomes necessary. This thinning operation extends from the time of pollination until the fruits reach considerable size. The above data show that the fruits become richer in nitrogen, phosphorus, and potassium with increasing maturity and that the longer the thinning is delayed, the more of these constituents is lost. Thus, for example, if 27,000 fruits are allowed to remain on a palm until June 10, and 18,000 of these remain until July 1, and 9,000 thereafter, the loss of potassium due to late thinning would amount to 0.5625 pounds; that of nitrogen 0.2952 pounds, and that of phosphorus 0.049 pounds, if we do not allow for the probable competition between fruits of the final crop and those thinned. On an acre basis (50 palms) these losses would amount to 28.125 pounds, 14.76 pounds, and 2.45 pounds, respectively. If such fruits were allowed to remain on the soil, the constituents while not lost, would of necessity have to undergo the complex reactions in the soil before again becoming available. This delay in thinning may be due to three main causes: (1) the lack of available assistance and the amount of labor involved; (2) the desirability of knowing the extent of "June drop;" and (3) the degree of success attained in the pollination. Notwithstanding, it seems desirable from a nutritional standpoint to thin as early as possible.

The amount of total sugars as dextrose is relatively low until after July 22 after which it increases with remarkable rapidity. Prior to July 22 the total sugar content consisted largely of reducing sugars, after which the non-reducing sugars, including sucrose, predominated. On September 20 at which time some of the fruits in the sample were fully ripe, the non-reducing sugars including sucrose accounted for about 56 per cent of the total sugars. Analyses of the sugar content of whole fruit and of stem and tip halves (no calyx or seed) at various times during the season showed that in every case the percentages of reducing sugars were higher in the tip than in the stem halves and conversely those for non-reducing sugars, including sucrose, were higher in the stem halves.

### Studies on the Nature and Control of Water Injury

During the years 1930 and 1931 Nixon (4) succeeded in artificially inducing mild and violent splitting of the epidermis of detached fruits by soaking them in water at various stages of maturity. When the fruits were of a pronounced green color there was very little effect but in the khalal stage the epidermis was ruptured violently. Between these stages of maturity small transverse checks were produced which resembled those found in the initial stages of blacknose. It was thus possible to imitate various types of checking depending on the maturity of the fruit sample.

In order to learn more of the intimate nature of checking, we examined microscopically pieces of the epidermal layer in surface view and found them to contain ruptures of various sizes. These checks at first involved only the cuticle and outer wall of the epidermal cells and usually did not follow the lateral walls as lines of cleavage. In cross section the minor checks appeared as shallow cell ruptures but the larger splits in some cases involved tissues as much as 16 cells below the epidermis. These scars in all probability do not heal over, which exposes the underlying tissues to desiccation to a degree depending on the size of the rupture. Initially, in young fruit the smaller ruptures are not visible except through the microscope. Later, however, the cells which border the splits die and this necrotic border makes the split more visible. These brown, dead borders may easily be mistaken for callus when in

fact no callus has as yet been found.

The position and direction of the checks in the epidermis may differ in the different varieties as has already been noted by Nixon (5). In Deglet Noor dates the checks are mainly in a transverse direction and are located mostly in the region near the tip. In both Iteema and Tafazwin dates the checks are also transverse but for the most part are situated near the equator, while in Hayany the checks are largely longitudinal and in the tip half. The checks on the three latter-mentioned varieties appear analogous to those of Deglet Noor which are considered by Nixon (5) as being associated with and probably largely responsible for blacknose, a symptom thus far only associated with the Deglet Noor variety. The checking in the above mentioned varieties not including Deglet Noor was not accompanied by an abnormal blackening and was not always confined to the tip or "nose" portion of the fruit. According to the definition of "blacknose" given by Nixon (4) these fruits would not be affected by this malady, but we may say that they all show symptoms of water injury.

In 1932 a study was made in the field on the effect of time and method of bagging with paper tubes in the percentage of fruit affected with checks. The smallest percentages of affected fruits were found in bunches which were not bagged, while the highest percentages were in those bagged on July 22. A method such as bagging which is commonly employed for the purpose of reducing the injury from rain may, if applied sufficiently early, greatly increase the number of fruits checked. No symptoms of checking were observed in the field on July 22, while on August 12 a large amount was evident. It is probable that the first stages developed at some time during the interim.

Symptoms of blacknose developed in severely checked fruits and mostly in bunches bagged prior to August 12. Since no rain* fell between July 22 and September 29 the occurrence of blacknose was evidently due to other factors. The results of the field studies assume greater significance when compared with results of laboratory studies in which the tendency of fruits to check when immersed in water for 48 hours increased from 15 per cent on July 22 to a maximum of 97 per cent on September 1. During the period July 22 to August 12, 1932, the fruit passed through the most critical stage regarding checking. The time at which this critical period occurs may vary in different years. The characteristics of the fruit during this period, which appear to be factors affecting checking, are:

(1) Length, diameter, and fresh weight of the fruit are approaching a maximum; (2) the epidermis of the tip end shows relatively no growth after May 25 and is therefore unable to accommodate sudden increases in volume, resulting from the rapid intake of water; (3) after July 22 the amount of total sugars as dextrose in an average fruit is small at first but increases rapidly and is paralleled by similar changes in osmotic pressure which are sufficient to cause mild rupturing or checking; and (4) during this critical period it may be assumed that the transpiration rate would be higher and therefore the possibility of condensation moisture within the bunch greater than at later periods when the content of sugar is very high and that of water low.

Factors which tended to reduce checking following this critical period in 1932 (after August 12) were principally a decrease in the length, diameter, and fresh weight of an average fruit accompanied by a progressive shrinkage of the pulp and a lessening of epidermal tension beginning at the tip end and proceeding toward the base with increasing maturity. These factors evidently produced a condition in the fruit whereby sudden increases in volume at the tip were accommodated by the epidermis and no checking resulted.

During the late khalal and rutab stages therefore when the osmotic pressures are enormous the fruits are not ordinarily affected with checking as a result of water injury but show violent ruptures (tears) in the unripe, turgid, basal portion where the epidermis is unable to accommodate further increases in volume.

Symptoms similar to blacknose were produced by scratching fruits in the late green and in the khalal stages. These symptoms developed in the absence of rain.

After 118 hours immersion in water in the laboratory little or no relation was found between the percentages of attached fruits showing checks and those with tears that were produced by the immersion.

In 1932 the bagging of fruit bunches with paper tubes reduced the amount of tearing following rain and the percentage of torn fruits was further reduced by raising the skirts to allow more aeration. With skirts down, 7.2 per cent of the fruits were torn following rain; with skirts up, 3.3 per cent; while fruits in unbagged bunches showed 29.1 per cent tearing. A relatively high percentage of damaged fruits was found in a bunch protected with burlap (skirts down). This may be due to the penetration of rain through the bag and to the retention of free water in contact with the bunch.

A laboratory study on fruits collected September 13, 1933, showed that the rate of water loss from detached fruits was greater with increases in temperature and was considerable even at the lowest temperature (about 22°C). More water escaped from the stem than from the tip half. Calculated on the basis of 900 fruits, an average bunch would lose in a 24-hour period from about 0.5 pints of water at approximately 70°F. to about 6.5 pints at approximately 122°F. These amounts of transpiration water would, if held within the bunch, probably not only increase the humidity greatly but also be a source of condensation moisture.

Since free water has been observed by Nixon (4) as occurring in the interior of fruit bunches early in the morning following a humid day, it is reasonable to assume that the transverse checking in the field may also be largely the result of contact with free water formed by the condensation of transpiration water as well as that in the surrounding atmosphere.

Thus far we have not observed fruits affected with dark-colored tips without at the same time observing the accompanying transverse checks. Hence, if checking can be prevented the blackening of the tips will also be controlled.

In our initial experiments in the control of transverse checking the attempt was made to greatly reduce the transpiration water by means of coating the fruits with oil emulsions. It was observed in one garden that the use of heavy oil emulsions prevented normal maturation. Although experiments, if continued, in this direction may lead to a control, we abandoned such an attack for the reasons that the rate of fruit maturity may be affected and because of the necessity of removing undesirable residues from the epidermis after harvesting.

The effect of early seasonal bagging (July 26 to August 17) was that of greatly increasing the percentage of checked fruits. The checked fruits in bunches in which the strands were

separated for the purpose of improving aeration were decreased 17 and 35 per cent, respectively, in groups pollinated early and in midseason. Furthermore, the market quality of aerated fruit was superior to that of orchard run and was markedly superior to that which was bagged early. Since by this method the percentages of checked fruits have been decreased below that of orchard run and the quality markedly improved, this line of attack suggests a means of control for water injury, and hence of blacknose. Certain steps in this direction are already in use, such as the removal of the center fruit strands, the insertion of wire rings between the strands, improved types of material and ventilation of tubes (bags), and the elevating of low hanging bunches away from the soil.

In the light of our experiments the practice of bagging fruit bunches with paper tubes is highly desirable and serves as a protection against rain and birds. However, it is attended with the disadvantage that the covers tend to retain the transpiration water and hinder aeration, thus accentuating water injury. In our opinion an ideal bag would be one which protects the fruits from rain and birds and at the same time allows a maximum aeration, but is one which is not installed until necessary as a protection.

Nixon(5) distinguishes four types of rain damage: (1) severe splitting of the skin (tearing); (2) fruit spots due to fungi; (3) fermentation and souring of dates; and (4) small, lineal skin ruptures (checks). Although all of these types of injury are associated with periods of rain, only checking and tearing are considered by us as being primarily due to water injury.

From our studies two distinct types of water injury were found: (1) checking, which occurs largely in the late green and in the khalal stages; and (2) tearing, which develops largely in the late khalal or rutab stages. Tearing is not dependent on either checking or blacknose and consequently may occur on the unripe, basal portion of normal, checked, or blacknosed fruits in the late khalal or rutab stages. Since the blackening and shrivelling characteristics of blacknosed fruits may be produced by scratching, it appears that these symptoms following checking may be independent of water injury.

(1) Cleveland, M. M., and C. R. Fellers. 1932. Mineral composition of dates. Ind. and Eng. Chem. Anal. Ed. 4:267-268.

(2) Crawford, C. L. 1933. Growth rate of Deglet Noor dates. Date Growers Institute Rept. 10:8.

(3) Haas, A. R. C., and L. J. Klotz. 1931. Nutrition and composition of the Deglet Noor palm in relation to the decline disease. Hilgardia 5:511-530.

(4) Nixon, Roy W. 1932. Observations on the occurrence of blacknose. Date Growers Inst. Rept. 9:3-4.

(5) Nixon, Roy W. 1933. Notes on rain damage to varieties at the U. S. Experiment Date Garden. Date Growers Inst. Rept. 10:13-14.

*We are indebted to Mr. Dewey Moore at the U. S. Experiment Date Garden, Indio, California, for these readings which were made a few hundred feet away from the experimental bunches.

Footnote: Complete account of the investigations herein reported is being prepared for publication. Copies may be obtained from, Office of the County Farm Adviser, Riverside, California, bearing Citrus Experiment Station Number 310.

# Recent Pollination Experiments

By Roy W. Nixon, Associate Horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture

SINCE it was first discovered in 1925 that the time of ripening of the fruit of the date palm could be affected by pollen an effort has been made from year to year to find males that might produce earlier or later ripening than those reported at the Third Annual Date Growers Institute. So far no males of the true date palm (Phoenix dactylifera) have been discovered that go beyond the range of two tested the first year at the U. S. Experiment Date Garden—Fard No. 4 (early ripening) and Mosque (late ripening). But pollen of another species, Phoenix canariensis, tested the first year in several experiments, gave somewhat later ripening than Mosque, and Phoenix Roebelinii pollen tested in 1927 gave very much later ripening than Mosque. However, it is not very practicable to use pollen from either of these two species commercially. Phoenix canariensis blooms from late summer to mid-winter. Most of the palms of this species in the desert complete their flowering season in January; pollen must be stored one or two months at least and it seldom gives as good a set of fruit on Deglet Noor as does fresh dactylifera pollen. Phoenix Roebelinii is a dwarf species with flower clusters too small for commercial use. Neither of these two species of Phoenix produces offshoots.

In 1931 a young male of Phoenix reclinata type grown at the U. S. Experiment Date Garden from seed from a palm in front of the Santa Barbara Mission bloomed for the first time late in the season. In the two tests made that year this pollen produced later ripening than Mosque. The following year the male flowered earlier and yielded more pollen. Eleven tests on Deglet Noor were made—9 at the U. S. Experiment Date Garden and two at Sacaton, Ariz., the different pollens being applied to different strands on the same bunch in each instance. In every test pollen from this male, which was designated as Reclinata No. 1, produced much later ripening than Mosque as Mosque is later than Fard No. 4. Experiment No. 37 is a good illustration. The record, as given in Table I, when plotted graphically, shows at 50 per cent of the crop a difference in time of ripening of Mosque as about three weeks later than Fard No. 4 and Reclinata No. 1 as approximately four weeks later than Mosque.

In 1933 readings were obtained on the ripening produced by Reclinata No. 1 in 24 experiments—14 on Deglet Noor, four on Khadrawy, two on Khalasa, two on Barhee, one on Halawy, and one on Sayer. In all of the experiments on Deglet Noor very late ripening was produced, quite comparable to previous results. However, on other varieties there was no such consistency. In a few instances the ripening produced by Reclinata No. 1 was almost as early as Fard No. 4; in others it was nearer to Mosque but not later. Mosque and Fard No. 4, both seedling males of the true date palm, in the same experiments on these varieties, and in

other experiments on other varieties, have always produced differences in time of ripening as well as differences in size of fruit and seed more or less comparable to the differences produced on Deglet Noor. The tests that have been made with Phoenix reclinata pollen on varieties other than Deglet Noor are insufficient for final conclusions, but it is evident that with any particular variety experiments will have to be made to determine whether very late ripening can be secured. This study is being continued as it is important with varieties being grown on a commercial scale to determine the maximum control over time of ripening possible through pollen.

Meanwhile it is quite evident that with pollen of Phoenix reclinata of the type represented by the male at the U. S. Experiment Date Garden the ripening of Deglet Noor fruit can be delayed much later than is possible with any of the seedling dactylifera males now in use. Males of this species could be used commercially. They produce offshoots so that individual strains can be propagated; they flower in the spring and the set of fruit on Deglet Noor and all other varieties on which tests have been made thus far is equally as good as with any dactylifera pollen. There is, however, one drawback — the fruit, while apparently perfectly normal, is slightly smaller than that produced by any of the dactylifera pollens to which it has been compared. The average length of Deglet Noor fruit from Reclinata No. 1 pollen in 1932 was just a little over 1½ inches. On the other hand the seed-fruit ratio was much smaller than for any of the dactylifera pollens—5.4 per cent as compared with 7.5 per cent for Fard No. 4 and 10.1 per cent for Mosque in 1932. Experiments are being made this year to see if it will not be possible by drastic thinning to materially increase the size of the fruit and still retain the pronounced delay in ripening.

Due to the fact that differences in time of ripening produced by pollen are less pronounced early in the season it has been more of a problem to retard early ripening fruit than to accelerate late ripening fruit. In early localities where very early ripening sometimes results in a large percentage of inferior Deglet Noor dates the use of Phoenix reclinata pollen promises to be of distinct benefit. In other regions where danger of rain damage is lessened by a delay in ripening it may also prove to be of value.

In 1933 the first evidence was secured as to the inheritance of those characters in pollen that affect the time of ripening and size of fruit. Tests were made of a number of males grown at the Crane Date Gardens from seed resulting from carefully controlled pollinations at the U. S. Experiment Date Garden. Five Deglet Noor seedling males from Mosque pollen showed a distinct tendency to produce late ripening with large fruit and seed, while three Deglet Noor seedling males from Fard No. 4 pollen produced earlier ripening with smaller fruit and seed. One of the Mosque seedling males produced ripening slightly later than Mosque but further experiments will be necessary to determine whether this difference is significant. Otherwise, the effects produced by pollen from these seedlings were not quite as pronounced as those from pollen of the parents males, but they were consistently in the same direction. It should be noted also that the Deglet Noor seedling males from Fard No. 4 pollen were less vigorous and had smaller spathes than those from Mosque pollen — differences comparable to those between the parent males.

From time to time in the course of these experiments some minor differences in the seed-fruit ratio between different males independent of their effects on the time of ripening have been observed, but as the grade of fruit at present is not penalized for a large seed these differences have not appeared sufficient to justify much special investigation. In 1932 experiments on Halawy made in cooperation with Mr. Robbins Russel confirmed tests made the previous year in which it was found that one male with a low seed-fruit ratio showed a tendency to produce larger fruit than two others with a larger seed-fruit ratio. The difference in most instances was so obvious that it seemed to have commercial significance. So additional tests were made with the same pollens at the U. S. Experiment Date Garden in 1933. The results are summed up in Table II.

Males R-15 and R-18 were of particular interest because they are among the few males imported from the Old World and now used in commercial date gardens. They were compared to Mosque because of its extensive use in other pollination experiments. These three males

TABLE I

PROGRESSIVE RIPENING OF FRUIT IN EXPERIMENT NO. 37, 1932

On Deglet Noor 2-4-4

| Pollination date 4-21 | M* | F* | R* | M | F | R | M | F | R | M | F | R | M | F | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of observation | 9-14 | | | 10-5 | | | 10-21 | | | 11-1 | | | 11-21 | | |
| Total | 89 | 69 | 66 | 89 | 69 | 66 | 89 | 69 | 66 | 89 | 69 | 66 | 89 | 69 | 66 |
| Ripe | 0 | 5 | 0 | 14 | 43 | 3 | 36 | 68 | 12 | 59 | 69 | 12 | 88 | 69 | 38 |
| Partly ripe | 6 | 15 | 0 | 17 | 24 | 7 | 28 | 0 | 3 | 25 | 0 | 14 | 1 | 0 | 9 |
| Immature | 83 | 49 | 66 | 58 | 2 | 56 | 25 | 1 | 51 | 5 | 0 | 40 | 0 | 0 | 19 |
| Ripe & partly ripe (per cent) | 7 | 29 | 0 | 35 | 97 | 15 | 72 | 99 | 23 | 94 | 100 | 39 | 100 | 100 | 71 |

*M—Mosque; F—Fard; R—Reclinata No. 1.

TABLE II.

WEIGHT IN RELATION TO SEED-FRUIT RATIO

| | No. of Exps. | Mean Wt. date-gms. | Highest as 100% | Mean Wt. seed-gms. | Seed-Fruit ratio—Pct. |
|---|---|---|---|---|---|
| Halawy (Russel-1932) | | | | | |
| Mosque | 2 | 6.66 | 99.0 | 1.15 | 17.3 |
| R-15 | 5 | 6.20 | 92.1 | 1.00 | 16.1 |
| R-18 | 7 | 6.73 | 100.0 | .94 | 14.0 |
| Halawy (USDG-1932) | | | | | |
| Mosque | 5 | 6.30 | 81.6 | 1.05 | 16.7 |
| R-15 | 7 | 6.89 | 89.2 | 1.01 | 14.7 |
| R-18 | 4 | 7.72 | 100.0 | .93 | 12.1 |
| Halawy (USDG-1933) | | | | | |
| Mosque | 8 | 6.61 | 100.0 | 1.08 | 16.3 |
| R-15 | 6 | 6.24 | 94.4 | 1.04 | 16.7 |
| R-18 | 6 | 6.57 | 99.2 | .88 | 13.4 |
| Halawy* (USDG-1933) | | | | | |
| Mosque | 1 | 6.19 | 91.4 | 1.08 | 17.4 |
| R-15 | 1 | 5.90 | 87.1 | .96 | 16.3 |
| R-18 | 1 | 6.77 | 100.0 | .88 | 13.0 |
| Deglet Noor*(USDG-1933) | | | | | |
| Mosque | 5 | 9.79 | 100.0 | 1.07 | 10.9 |
| R-15 | 5 | 9.30 | 95.0 | .86 | 9.3 |
| R-18 | 5 | 9.53 | 97.3 | .90 | 9.4 |

*Pollens applied to different strands on the same bunch in each experiment

showed practically no difference in their effects on the time of ripening of Halawy; on Deglet Noor R-18 tended to be a little earlier than Mosque. On Deglet Noor it will be noted also that the larger seed is associated with the larger fruit which is the usual tendency. But on Halawy male R-18 not only produced a consistently low seed-fruit ratio but with the exception of the third set of experiments (1933) the size of the fruit was larger than with either of the other two pollens. Even in this instance where the difference in size of fruit was too small to be of any significance, because of the smaller seed the net weight of the flesh alone produced by R-18 was greater than that produced by Mosque.

The differences between R-18 and R-15 on Halawy were more consistent. From the third column in Table II it will be seen that the dates from R-18 pollen averaged from 4 to 15 per cent heavier than those from R-15 pollen. In other words with the same number of dates per palm the production of fruit might be expected to be increased in about the same ratio. On the basis of these data it was estimated that if R-15 pollen, used by Mr. Russel on Halawy palms before these experiments were undertaken, were replaced by R-18 there would be a probable increase of between 5 and 10 per cent in the crop. Mr. Russel having watched the progress of the experiments changed over to R-18 in 1933 and states that the anticipated increase in production has been actually realized.

Benefits derived in certain localities from changes in time of ripening by means of pollen have previously been reported. But while the effects of pollen on the size of fruit and seed have been pointed out since the beginning of these experiments in 1925, this is the first instance of an increase in size of fruit being made on a commercial scale by a change of pollen on the basis of experimental data and it is of particular interest because an increase in size of fruit was obtained without an increase in size of seed.

# Report of Progress: Date Scale Eradication

**By B. L. Boyden, Senior Entomologist, U. S. D. of A., Plant Quarantine and Control Administration**

FOR the past several years each program of the Date Growers' Institute has listed among the papers to be presented "Date Scale Eradication, a Report of Progress." I presume many of you wonder whether this progress is to continue indefinitely or if eventually the goal of complete eradication is to be reached.

Today I am presenting another report of progress and while I am not ready to say that the goal has yet been reached in any of the date growing districts, I feel safe in saying that by the end of the next fiscal year most of the date growing area may be considered free of Parlatoria Scale. At the present time I consider at least 50 per cent of the area in each of the districts clean.

As you know the Parlatoria Scale was brought into this country on date offshoots imported from the old world. I believe that the first importation of date palms was made in about 1888. From that time until 1922 a number of importations were made. The scale was recognized early as a serious pest and an attempt was made to eradicate it. The work was confined at first to the imported palms, but eventually the scale spread to seedling plantings. By 1926 the scale seemed well under control but in 1927 several heavy infestations were found in Arizona and California, and an appropriation from Congress was obtained and a survey of the entire date growing area was begun. This survey was completed in the fall of 1928 and from the information obtained from it and a study of the past work against the insect, a report was prepared which was submitted to the Growers' Pest Control Committee, the Agricultural Departments of Arizona and California, and the Federal Horticultural Board.

After carefully considering the problem it was decided that eradication was desirable and feasible and the agencies involved agreed to cooperate in the project. Funds were made available about January, 1929, from the emergency fund of the State of California to proceed with the program as agreed upon until adequate funds could be appropriated by the State legislatures and Congress.

The eradication program was based on the belief that by proper and frequent inspection infested palms could be located and treated before there was any spread to adjoining palms. Therefore, the first procedure was to hire and train a force of inspectors large enough to take care of the entire date area. A number of heavy infestations were found during the survey and it was certain that there had been considerable spread from these. Therefore, our area of inspection was enlarged as rapidly as possible. By July, 1929, an adequate inspection force was ready and a careful leaf by leaf inspection of the Coachella Valley was begun. When this was completed an infested area was designated which included all the plantings within two miles from the heavy infestations or centers of spread. The plantings in this area were to be inspected at least twice a year until all the infestations resulting from spread from the centers were located and cleaned up. The plantings outside the infested area were to be inspected once a year.

All the plantings were listed according to the length of time necessary to inspect. The larger ones were taken care of by routine crews and the smaller ones by scout inspectors working in pairs. While we felt sure that the larger plantings had all been located by the survey it was quite probable that some small abandoned plantings had been overlooked. Therefore, the scout inspectors were supposed to locate and report unlisted plantings. When it was believed that all possible palms had been located in this manner a careful survey was begun by the scout inspectors. Taking the section as a unit the entire Valley from about four miles south of Mecca to the same distance north of Indio was covered. The reports submitted by the inspectors consisted of a sketch of the section with a description of the natural growth or planting there on.

The survey of 1928 disclosed the fact that there were many uncared for seedling plantings, some infested, which could not be inspected properly. Scale could breed upon these

plantings and spread to commercial gardens before the infestations could be located. It was obvious, therefore, that eradication of the scale was hopeless unless these plantings in the infested area were dug out, or thinned out and pruned so that they could be inspected properly. Early in 1929 when funds were available for this work digging valueless palms in the infested area was begun and continued as fast as the consent of the owners was obtained. Many thousands of valueless palms were dug out and destroyed. After the palms were dug the properties were checked from time to time and volunteer palms growing from seed and portions of the old stumps left in the ground were destroyed. This is quite essential in the case of infested properties as proved by the fact that three infestations have been located on properties on which all the palms were supposed to have been destroyed.

Our progress from year to year is indicated by the total number of infested properties, and the number of infested palms, also the number of new infested properties.

**In 1928,** 22 infested properties were found in the Coachella Valley, five of them new. A total of 1,592 infested palms were found and treated. This was a result of the preliminary survey and more intensive work in the known infested gardens.

**In 1929,** 32 infested properties were found, including 17 properties not previously known to be infested; 588 infested palms were found. This was a result of the leaf-by-leaf inspection of the Valley and from later results it would seem that practically all infested plantings which could be inspected properly were found during this year.

**In 1930,** our inspection crew was well trained and large enough to cover the Valley properly. Intensive inspection was carried on and 20 infested properties, of which five were new, and 186 infested palms were found. Three of these new infestations were in bushy uncared for seedling plantings, one was a recurrence of scale in a seedling garden which had been previously infested in 1925 and 1926 and supposedly cleaned up, and one a single lightly infested palm found in a planting of a subdivision where a heavy infestation was found in 1929. This palm was treated and we have found and expect to find no further scale in the planting. The seedling planting in which the recurrence was found and one of the other seedling plantings were dug out; 1,454 palms were dug out in one of the other seedling plantings and the remaining 296 palms pruned for inspection. The remaining planting was a seedling subdivision covering approximately one-half a section. It had been neglected for many years and most of the palms had died. Desert growth made proper inspection impossible. It was only after breaking down the brush with a tractor when digging palms that the first infested palm was found; 1,234 palms were dug out, leaving 88, which were pruned properly for inspection.

**In 1931,** intensive inspection continued and 17 infested palms were found on four properties, none of them new. Of these 17 palms, 13 were seedlings of no value and were dug out and destroyed; only single dead scales were found on two of the remaining four and were not treated; the other two were lightly infested and treated.

**In 1932,** intensive inspection was continued and no scale was found.

**In 1933,** inspection was continued with a smaller crew, as ladder work was not necessary in certain areas and less frequent inspection was necessary in other areas.

**In 1934,** to date we have been doing necessary inspection and cleaning up odds and ends. No scale has been found since November, 1931, and no new infestations since June, 1930.

There are two types of infestations to consider; leaf infestations and leaf-base infestations. When an infestation builds up to a point where it spreads by wind or birds to other palms the new infestations naturally occur on the leaves. If found promptly the defoliation of the palm cleans it permanently. However, if the infestation is not found for some time and the scale breeds up and scatters over the palm, getting down under the fiber, defoliation will not remove it. In treating such an infestation the fiber is split and pulled down and the exposed leaf-bases treated. However, past experience has proved that even after careful treatment the scale persists on the leaf-bases and sometimes will breed up and spread to the foliage. This is especially true when the scale is on the bases in the offshoot bearing area. In the past year the leaf-bases on many previously infested palms have been removed and inspected. From the experience to date it would seem that the leaf-bases on the Deglet palms die back rather rapidly so that if the offshoot bearing period is over and the palms have been inspected for a reasonable length of time they may be considered safe. The leaf-bases on the seedling palms, however, seem to remain alive and a breeding ground for scale for many years. Also the seedling seems to have a habit of developing an offshoot at any time on any place on the trunk. These inferences are substantiated by many instances of recurrence of scale in the past.

The other palms which are also attacked by the Parlatoria Date Scale influence our eradication work, the fan and Canary Island palms particularly. From our experience to date I would say that the new leaves of the fan palms are as susceptible to infestation as the date. However, as the leaves grow older they seem to harden and are much less attractive to the scale. Due to this fact and the rapid growth of the fan palms it is possible that the scale would die out unassisted on an old fan palm. The leaf-bases on the fan palms present no problem as they harden and die comparatively rapidly. The Canary Island palms seem to be as susceptible to Parlatoria Scale as date palms. The fact that the leaf-bases harden rapidly, however, lessens the chance of recurrence. Nevertheless, we are taking no chances with them.

This I hope will give you an idea of the procedure to date. The present status in the Coachella Valley is about as follows:

We are about satisfied that we have located all infested properties and cleaned up all leaf infestations. There is still some inspection we wish to do around the last heavy infestations, also in a few plantings where bushy palms remain or were pruned recently.

Of the 2,383 palms found infested in 1928 and since that time approximately 1,591 were seedlings and 792 standard varieties. These figures include recurrences. I might say also that many seedlings which were dug out in our clean-up work before careful inspection, were probably infested.

Of the 1,591 seedling palms reported infested not more than 60 remain, the others have been destroyed. Some of these remaining seedlings have been given leaf-base inspection and we hope to treat the others where necessary. There are also a few previously infested seedlings remaining from infestations prior to 1928 which we intend to give leaf-base inspection, although most of the early infested seedling plant-

ings were dug out in our clean-up work.

There are some standard variety palms which because of their past history should have further treatment. This will be done as soon as possible.

The same procedure used in the Coachella Valley was carried out in the Salt River Valley and Imperial Valley and at Yuma.

The Parlatoria Scale was first recognized as a pest in the Salt River Valley and the first eradication work done there. Commercial date growing did not develop there as soon as in the Coachella Valley and there were fewer infested palms to deal with. The scale seemed to be entirely eradicated in the Salt River Valley in 1926. However, some heavily infested seedling palms were found near Phoenix in 1927; 59 infested palms were found on eight properties.

This quotation from the 1927 report of H. B. Skinner, representing the State of Arizona in the eradication work, is interesting: "An old male palm on the Reberger place at Indian School Road and Seventh Street was found to be infested with Parlatoria Scale early in August. This palm had been treated for Parlatoria Scale about three years previous and no scale found during the three-year interval, although the palm had been inspected many times."

Systematic inspection was begun in the Salt River Valley as soon as funds were available and has continued to date. Also the entire area was covered by a section-by-section survey. A total of 157 infested palms, including recurrences, were found during the campaign. The last scale being found in Phoenix in October, 1932. Thousands of offshoots have been shipped from the Coachella Valley, some from gardens afterward found infested. These have been kept under observation. Most of the necessary inspection work has been done in the Salt River Valley and we hope to have the leaf-bases removed from previously infested palms by the end of this month.

In the Yuma district the City of Yuma was generally infested previous to 1925. In 1925, 91 infested palms were reported. Since 1926, only 15 infested palms have been found and these on previously infested properties. There is considerable leaf-base work which should be done in Yuma and several seedling jungles which should be thinned out, also some inspection. The last scale was found in Yuma in December, 1930.

There have been few infested palms found in Arizona as compared with the number found in California. But in eradication, as you know, the last one is the important one. Also it is much more difficult to find one infested palm among 1,000 than one in 50 for obvious reasons.

**In 1928,** a hasty survey of the Imperial Valley was made and that part south of Holtville found to be pretty generally infested; 1,077 infested palms were found on 33 properties, 25 not previously recorded; 804 of these infested palms were in a large seedling garden.

**In 1929,** 164 infested palms were found on 49 properties, 31 of them not previously recorded as infested.

**In 1930,** 89 infested palms were found on 24 properties, 11 of them new.

**In 1931,** 26 infested palms were found on 11 properties, two of them new; two of these were Canary Island and six fan palms found during a survey of palms other than date.

**In 1932,** 43 infested palms were found on six properties, three of them new; 36 were Canary Island palms on a place where no date palms were planted and were heavily infested; four were lightly infested fan palms.

**In 1933,** ten infested palms were found on three properties, none of them new. One of these properties, a commercial garden of 538 palms, was, I believe, infested and cleaned and then reinfested from the heavy infestation on Canary Island palms found in June, 1932. Seven infested palms were found in this garden. One infested Canary Island palm was found on a previously infested place near Holtville. One infested palm was found on a property which was infested in 1923 and 1924 and all the palms were supposed to have been dug at that time. The infested palm was small, growing in the weeds along a ditch bank. The other infested palm was in a small seedling planting which was first found infested in July, 1931.

**In 1934,** to date three infested palms have been found in the commercial garden which showed scale in 1933.

Of the 1,412 palms found infested in the Imperial Valley in the past six years, all except 172 have been dug out and destroyed. Some of the remainder have had their leaf-bases removed and we expect to treat the remainder so that there will be no danger of a recurrence of the scale. Considerable inspection remains to be done, but we expect to have most of the Imperial Valley completed by the end of the next fiscal year.

**1934 COACHELLA VALLEY PALM CENSUS**
**Compiled by B. L. Boyden, Sr. Entomologist, U. S. D. A.**

| District | Standards 1-4 | Standards 5-9 | Standards 10 | Nsy. | Total Stand. | Seedlings | Total Palms |
|---|---|---|---|---|---|---|---|
| Indio | 11,686 | 9,055 | 4,604 | 3,427 | 28,772 | 1,862 | 30,634 |
| Indio Hei hts | 5,703 | 4,889 | 2,004 | 2,239 | 14,835 | 1,383 | 16,218 |
| Indian Wells | 15,973 | 5,435 | 3,438 | 5,637 | 30,483 | 2,934 | 33,417 |
| Palm Springs | 428 | 879 | 153 | 77 | 1,555 | 1,786 | 3,341 |
| High School | 14,195 | 6,466 | 2,369 | 1,567 | 24,597 | 2,566 | 27,163 |
| Coachella | 7,336 | 2,625 | 842 | 2,110 | 12,913 | 2,719 | 15,632 |
| West Side | 788 | 385 | 1,118 | 274 | 2,565 | 455 | 3,020 |
| Arabia | 785 | 859 | 451 | 396 | 2,491 | 2,909 | 5,400 |
| Dos Palms | 532 | 296 | 10 | 83 | 921 | 3,250 | 4,171 |
| Thermal | 4,105 | 1,191 | 2,963 | 4,233 | 12,492 | 831 | 13,323 |
| Martinez | 3,836 | 1,974 | 1,420 | 3,084 | 10,314 | 201 | 10,515 |
| Mecca | 431 | 267 | 1,221 | 673 | 2,592 | 2,147 | 4,739 |
| Oasis | 4,374 | 1,477 | 262 | 376 | 6,489 | 4,533 | 11,022 |
| Totals | 70,172 | 35,816 | 20,855 | 24,176 | 151,019 | 27,576 | 178,595 |

*Above includes 1933 plantings, but not 1934

# Eleventh Annual Date Growers' Institute

## Afternoon Session

## Note on the Frost Resistance of the Date Palm

**By Robert W. Hodgson, University of California**

**Remarks of Chairman in Opening Afternoon Session**

IN December, 1932, there occurred in the Sacramento Valley of northern California the most disastrous freeze on record for that part of the state. Of comparable freezes with reference to minimum temperatures, it was the earliest of record, December 9 to 16 inclusive. The duration of injurious temperatures was also the longest ever recorded for the region.

These two characteristics of this record-breaking cold wave are illustrated by the record from a thermograph operated in one of the citrus districts, which registered a minimum of 11 degrees F. December 11, 51 hours of 20 degrees F. or lower, and 21 hours of 15 degrees F. or lower. Temperatures of 6 degrees F. to 18 degrees F. were registered in the fruit-growing districts. Moreover, the freeze was accompanied by strong, steady north winds with an estimated velocity of 30 to 35 miles per hour.

The earliness, suddenness, duration and severity of the freeze, the warm weather which preceded it, and the wind which accompanied it, all combined to accentuate the injury it caused. An unprecedented opportunity was offorded, therefore, to observe the resistance of subtropical fruit plants to low temperatures and to record the effects which such temperatures produce. Observations were made in July and August, 1933, in some fifty localities where official temperature records or reasonably accurate records from other sources are available.

Date palms are, of course, comparatively scarce in the Sacramento Valley. There are a few, however, on both the east and west sides of the Valley. Of these, certainly the largest and best known group is that on the famous old Wolfskill ranch near Winters. Included in this group are some of the oldest and tallest date palms in the state and a number which have fruited more or less regularly for many years past. Isolated trees occur in a number of places on both sides of the Valley, some of the oldest and largest being found in the vicinity of Oroville. A few also are included in the plantings at the Government Plant Introduction Garden near Chico. An effort was made to visit every palm in the areas where damaging low temperatures were experienced.

At temperatures of 10 to 12 degrees F. the leaves seemed all to be killed though it was evident that the terminal buds had not been killed, new growth having occurred in every palm seen. Some had even put out spathes and bloomed. In all cases, however, the flower clusters were poorly developed and little or no fruit had set. It was evident that the low temperatures had weakened or injured the flower buds. In one instance year-old and two-year-old planted offshoots were seen which were apparently dead. No dead attached offshoots were found though the leaves on all had been killed.

At temperatures of 14 to 16 degrees F. the injury was only slightly less evident. A few only of the leaves on large, old palms had escaped death. This was true of the tallest palm on the Wolfskill place, a tree 35 to 40 feet tall.

The evidence available from this freeze, while small in amount, indicates that young palms or detached offshoots may be seriously injured or killed by temperatures of 10 to 12 degrees F. but that temperatures considerably lower are required to kill palms of bearing age, though temperatures of 14 to 16 degrees F. are sufficient to kill practically all of the leaves.

It may be of interest to note that no evidence was seen of differences in frost resistance between the date palm, Phoenix dactylifera, and the Canary Island palm, P. canariensis. On the other hand, a notable difference was observed in the two common species of California fan palms, Washington filifera, and W. gracilis (robusta). The latter was much worse injured than the former and is undoubtedly less hardy than the date palm.

## The Effect of Humidity and Containers On Dates

**By Wm. R. Barger, Associate Physiologist, Bureau of Plant Industry, United States Department of Agriculture**

IN OUR experiments in handling and storing dates, high moisture content of the fruit has stood out as an important factor of deterioration by making the fruit more susceptible to sugar changes and mold. Cold storage temperatures control the development of mold in storage but temperatures as low as 5 deg. F. have merely slowed up sugar deterioration of moist dates. A moist date means not only one that has a moist, rutab consistency when placed in storage but also one that gains rutab consistency by absorbing moisture in storage.

The term "sugar deterioration" meaning the formation of sugar spots, crystals, and syrup, is used for want of a better one and designates a change in sugar consistency and appearance greater than is allowable for prime dates of the variety and type. For example, a prime dark soft Deglet Noor has more syrup than a prime amber-hazel colored Deglet Noor. A sugar

deteriorated date is not a spoiled article of food.

Prof. Christie mentions (Value of Wax Wrappers for Carton Packed Dates. Second Ann. Date Inst. 1925) three types of spoilage due to packing dates in cardboard boxes, which are; loss of weight resulting in a dull appearing dry product, formation of sugar crystals, and insect infestation. This spoilage, occurring at retail store temperatures at which the tests were run, was retarded by well-sealed wax-paper wrappers. He experienced no trouble from molding and souring because well-cured dates were used.

Under present conditions, the crop is so large that most of it goes into cold storage before it is distributed and also so large that it has been considered uneconomical to cure much of the crop to a non-molding, non-souring, slow sugar-changing consistency. Insect infestation is controlled by fumigating the fruit before packing and by cold storage. The lack of insect activity in cold storage makes it possible to use package wrappers that can be sealed economically although not insect-proof at the fold.

The causes of spoilage of harvested dates, aside from insect invasion, can be listed in detail as follows:

(1) Sugar spotting of dates containing a large amount of invert sugar. These nearly round masses of sugar sometimes as large as 3 to 4 mm. across appear under the skin and spoil the appearance of the fruit.

(2) The excessive darkening in color, loss of lustre, and formation of syrup in dates having a large amount of fruit cane sugar.

(3) Molding and souring.

(4) Excessive drying of the fruit after storage.

The formation of cane sugar crystals on the skin of dates mentioned by Prof. Christie is serious only when dates lose an excessive amount of moisture.

Moisture plays an important role in all this spoilage.

In our experiments, non-packed dates and fruit in various packages have been held in air of known relative humidity and temperature in commercial cold storage rooms and warm rooms comparable in temperature to retail stores. Small lots have been held in chambers where the relative humidity of the air was controlled by the Regnault-Sorel mixtures of sulphuric acid and water. The weight of the fruit was taken and moisture analyses by the Bidwell-Stearling method using toluene were made from time to time.

The moisture in the air in commercial cold storage rooms and its possible effect on dates to be stored should be well understood by people who handle dates. In general, fresh fruit requires fairly high humidity in storage for the preservation of appearance but dates, both rutab and cured, deteriorate in high humidity. Commercial 32 deg. storage rooms usually have a relative humidity between 80 and 95 per cent and a relative humidity of 75 to 85 per cent is considered low by storage people, since it will dehydrate most fresh fruits. Dates require a relative humidity around 65 per cent to maintain a stable moisture condition at 32 deg. temperature. The relative humidity of air in rooms below 32 deg. F. is high but the moisture exchange between dates and air at temperatures below the freezing point of water is slow. Contrary to expectation the air in 40 deg. and 50 deg. rooms in storage plants contains more moisture than that in 32 deg. rooms and this is because the rooms are piped to maintain a temperature of 32 deg. and it is necessary to intermittently shut off the refrigeration to maintain the higher temperatures. This intermittent refrigeration causes defrosting of the pipes which adds moisture to the air and so the method of lowering relative humidity by raising the air temperature is not available in commercial storage plants.

Table I shows the change in weight and time for deterioration to become noticeable for several varieties of dates held in wire baskets at various average temperatures and relative humidity. Deterioration is noted as slight (S) and bad (B) for darkening of color and excessive syrup for-

TABLE I.
EFFECT OF HUMIDITY AND CONT. ON DATES

| Variety Type | Fruit Moisture At Start | Avg. Temp. ° F. | Avg. Rel. Hum. % | Total Gain in Weight (%) of Dates Not Packed — Months ½ | ¾ | 1 | 1½ | 2 | 3 | 4 | 6 | 8-9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEGLET NOOR | | | | | | | | | | | | |
| Cured | 23% | 34 | 85 | | | 1.7 | | | 3.1 | 3.5S | | |
| Rutab | 26% | 34 | 85 | | | | | | | 2.0S | 4.0S | |
| Rutab | 28% | 34 | 92 | | | | | | | | 5.0B | |
| Rutab | 34% | 34 | 85 | | | | | | 0.0 | | .0B | |
| Dry Amber-Hazel | 9% | 70 | 65 | 3.5 | | 7.4 | | | | | | |
| Cured Dark Soft | 19% | 70 | 65 | .3 | | -.4 | | | | | | |
| | | 70 | 85 | 1.6 | | 3.2S* | | | | | | |
| Rutab Dark Soft | 24% | 70 | 65 | | -2.2S | | -3.8S | | | | | |
| | | 70 | 85 | | .5S | | .9B | | | | | |
| Amber-Hazel | 25% | 70 | 65 | -.4 | -1.4 | 1.6S* | | | | | | |
| | | 70 | 85 | 1.0 | 1.6B | 2.3B* | | | | | | |
| KHADRAWI | | | | | | | | | | | | |
| Cured | 12% | 5 | 83 | | | | | | | 1.0 | 1.3 | 1.9 |
| | | 18 | 86 | | | | | | | | 2.7 | |
| | | 27 | 86 | | | | | | | 6.1 | 9.2B | 12.4 |
| | | 32 | 86 | | | .8 | | 3.6 | 6.2 | 8.9S | 11.5B | |
| | | 40 | 93 | | | 3.8 | | 8.0S | 13.3B | 18.6* | | |
| Cured | 14% | 34 | 93 | | | 3.8 | | 8.0 | | 11.5B | | |
| Cured | 14% | 70 | 65 | | 3.1 | | 5.3S | | | | | |
| | | 70 | 85 | | 8.7B | | 15.7B | | | | | |
| Rutab | 18% | 5 | 83 | | | | | | | | .0S | .3B |
| | | 34 | 85 | | | .1 | | .7 | 2.0B | | | |
| HALAWI | | | | | | | | | | | | |
| Cured | 14% | 5 | 83 | | | .3 | | .3 | .3 | .4 | .9 | 1.6 |
| | | 18 | 86 | | | | | | | | 1.8 | 3.7S |
| | | 27 | 86 | | | | | | | 3.8 | 6.9S | 9.7S |
| | | 32 | 86 | | | .6 | | 1.3 | 1.8 | 5.9 | 8.2S | |
| | | 40 | 93 | | | 1.7S | | 4.1 | 7.0 | 9.7B | | |
| Rutab | 21% | 5 | 83 | | | | | | | | .0S | .3B |
| | | 32 | 86 | | | | | -.4 | .5B | | | |
| SAIDY | | | | | | | | | | | | |
| Cured | 25% | 34 | 86 | | | | | | 4.0B | | | |
| ZAHIDI | | | | | | | | | | | | |
| Cured | 20% | 34 | 86 | | | | | | 5.0B | | | |

Note: *mold

mation of Deglet Noors, and as slight and bad sugar spotting of the other varieties. Mold in addition to sugar deterioration is also noted.

Deglet Noors, very moist with 34 per cent moisture at the start of 34 deg. storage, did not change in weight for six months while drier fruit, with 23 to 28 per cent moisture, gained 2 to 5 per cent during this time and, with the exception of the lot containing 28 per cent moisture at the start and which was held in air constantly above 90 per cent relative humidity, the drier fruit gained weight faster than the more moist fruit. Deglets starting with 23 to 26 per cent moisture deteriorated slightly in four months while gaining 2 to 3½ per cent in weight. Fruit starting with 28 per cent moisture gained 5 per cent in weight in high humidity in six months and deteriorated badly. The fruit with 34 per cent moisture at the start deteriorated without changing weight. No mold occurred in these lots at 34 deg. because the fruit cooled quickly to the room temperature.

Dry light-colored Deglet Noors held at an average temperature of 70 deg. F., and a relative humidity of 65 per cent gained 7.4 per cent in weight in six weeks while cured and rutab fruit lost weight. Dark soft rutab Deglets starting with 24 per cent moisture lost 2 per cent in weight in three weeks at this temperature and humidity, and deteriorated slightly while light-colored rutab Deglets starting with 25 per cent moisture lost 1.6 per cent in weight in four weeks, deteriorated slightly and started to mold. In high humidity at retail store temperature (70 deg.) cured Deglets gained weight faster, deteriorated more, and molded quicker than dark rutab fruit or "dark softs." Although invert sugar absorbs moisture faster, and loses it more slowly, than cane sugar, the saturation point for moisture of dates high in invert sugar seems to be below 25 per cent as compared to around 35 per cent for dates high in cane sugar and this difference in saturation point may account for the apparent reversal of the reaction in the case of dark soft and light-colored Deglets.

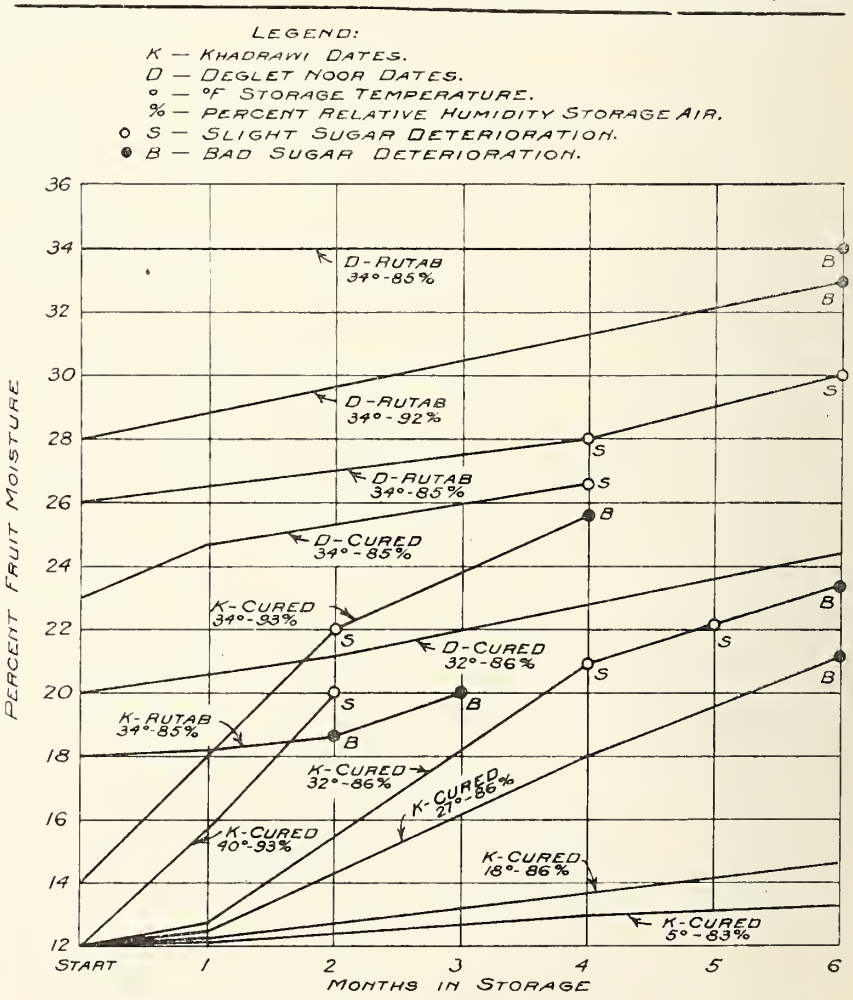
Khadrawi rutab fruit stored at 32 deg. F. with 18 per cent moisture, sugar spotted in three months and gained 2 per cent in weight, while cured fruit starting with 12 to 14 per cent moisture gained 9 to 11 per cent in weight in four months and sugar spotted soon after the moisture content reached 20 per cent. At 70 deg. 65 per cent relative humidity cured Khadrawi (14 per cent moisture) gained 3 per cent in weight in three weeks, while rutab dark soft Deglets (24 per cent moisture) lost 2 per cent, and at the same temperature but with 85 per cent relative humidity the Khadrawis gained nearly 9 per cent in weight in three weeks and were badly sugar spotted while the Deglets gained only ½ per cent in weight and had slight excessive syrup.

Table I also shows slight weight change and no sugar deterioration in cured Khadrawi and Halawi dates during six months at temperatures of 5 and 18 deg. F. and enough gain in weight in six months at 27, 32, and 40 deg. to bring the moisture content of the fruit up above 20 per cent. Sugar spotting occurred on the lots of these fruits that were allowed to gain moisture in storage. Rutab Khadrawi and Halawi fruit starting with 18 to 21 per cent moisture eventually sugar spotted at 5 deg. with practically no change in weight but the sugar deterioration was only slight during a storage period of six months.

Halawi rutab fruit with 21 per cent moisture gained only ½ per cent in weight in 32 deg. F. storage in three months and spotted badly in that time while cured fruit with 14 per cent moisture to start with gained 1.8 per cent in weight in three months and did not sugar spot until it had gained an additional 4 to 5 per cent more moisture.

Saidy and Zahidi dates of cured pliable consistency (25 and 20 per cent moisture) gained 4 to 5 per cent in weight in 32 deg. F. storage in three months time and sugar spotted severely during this time.

Table II shows the effect of packages on moisture exchange between dates and storage air of various degrees of temperature and humidity. Several types of packages aside from manila paper bags were used. One was the 8 oz. cardboard boat wrapped with ordinary and moisture-proof transparent cellulose and held in regular fiber-board shipping cases of 24 packages to the case. Another was the one-pound paper berry basket wrapped with ordinary transparent cellulose. The commonly used




ABSORPTION OF MOISTURE BY KHADRAWI AND DEGLET NOOR DATES IN STORAGE.

fiber-board round can with tin bottom and tin top and a newly developed round can with waxed lined fiber-board side, tin bottom, and moisture-proof transparent top were also used.

Light-colored cured Deglet Noor dates in non-moisture proof wraps gained over 7 per cent in weight in six months at 40 deg. F., 4 per cent at 32 deg., nearly 2 per cent at 27 deg. and lost only .2 per cent at 5 deg. In another test Deglets in non-moisture proof wraps gained 1.5 per cent at 32 deg. while fruit in moisture-proof wraps gained only .4 per cent at 27 deg. the gains were 1 per cent and .2 per cent respectively, and at 5 deg. the respective losses were .7 per cent and .3 per cent.

During six months storage, fruit with non-moisture-proof wraps at 40 deg. F. gained 7.6 per cent more moisture than fruit at 5 deg. and upon removal from storage the 40 deg. fruit dried faster than the 5 deg. fruit and was only 2.8 per cent wetter after four weeks. Packages of the same lots held in tin cans for a month after removal from storage resulted in the 40 deg. fruit being 5.9 per cent wetter than the 5 deg. fruit.

Table II also compares the effectiveness of waxed and non-waxed fiber-board cans and berry baskets with ordinary transparent wraps in controlling moisture transfer in cold storage and in dry air at retail store temperature. At 32 deg. F. light-colored Deglet Noor dates and Berhi dates both of rutab grade gained about 1 per cent in weight in four months in wax lined window cans while fruit in berry baskets gained 3.5 per cent. At 68 deg. fruit in wax lined window cans lost .7 per cent in three weeks while fruit in tin top cans lost 2 per cent and fruit in berry baskets lost 6.7 per cent. Cured Khadrawi dates at 32 deg. gained 1 per cent in four months in wax-lined window cans while fruit of the same lot gained 3.5 per cent in tin-top cans and 11½ per cent in manila bags. At 68 deg. cured Khadrawi dates lost .2 per cent in two weeks in wax-lined window cans, 1 per cent in tin-top cans, and 5½ per cent in manila bags.

### Conclusion

The data indicate that fruit moisture is an important factor in sugar spotting of invert sugar dates, and in excessive inversion of fruit cane sugar into syrup accompanied by darkening of color of cane sugar dates, and in supporting mold and yeast growth. Experiments are in progress to determine the limits of moisture allowable with prevention of these types of deterioration.

A single standard relative humidity to maintain dates at a constant weight without reference to temperature and composition of the fruit cannot be set. In tests where dates were exposed to air of the same relative humidity but different temperatures, the moisture change was twice as great at 70 deg. F. as at 32 deg. These results are logical because at any definite relative humidity there is more moisture per unit volume of air at high temperature than at low temperature. At 32 deg. a relative humidity of air around 65 to 70 per cent is necessary to maintain a constant weight with Deglet Noor dates compared to a relative humidity of 60 to 65 per cent needed for cured Khadrawi and Halawi dates. The difference in requirements between these varieties is probably due more to the lesser amount of moisture present in Khadrawi and Halawi dates compared with Deglet Noors of the same softness.

TABLE II.

| Variety Type | Fruit Moisture At Start | Avg. Temp. ° F. | Avg. Rel. Hum. % | Total Gain in Weight (%) of Packed Dates — Months ½ | 1½ | 2 | 3 | 4 | 6 | 10 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DEGLET NOOR | | | | | | | | | | | |
| Amber-Hazel Cured | 20% | 40 | 93 | | | 2.7 | | 4.8 | 7.4 | | |
| Non-moisture proof wraps | 20% | 32 | 86 | | | 1.2 | | 2.9 | 4.4 | 6.2 | 7.6 |
| | | 27 | 86 | | | .2 | | 1.1 | 1.8 | 3.0 | 3.8 |
| | | 5 | 83 | | | -.4 | | -.1 | -.2 | .2 | .3 |
| Non-moisture proof wraps | 23% | 32 | 86 | | | .5 | | 1.1 | 1.5 | 2.1 | 3.2 |
| Moisture proof wrap | 23% | 32 | 86 | | | .1 | | .2 | .4 | .7 | 1.1 |
| Non-moisture proof wraps | 23% | 27 | 86 | | | .3 | | .8 | 1.0 | 1.2 | 2.9 |
| Moisture proof wraps | 23% | 27 | 86 | | | .0 | | .1 | .2 | .2 | .6 |
| Non-moisture proof wraps | 23% | 5 | 83 | | | -.5 | | -.6 | -.7 | -.7 | -.7 |
| Moisture proof wraps | 23% | 5 | 83 | | | -.2 | | -.2 | -.3 | -.3 | -.3 |
| Hazel-Rutab waxed can window top | 23% | 68 | 50 | -.6 | -1.4 | | -2.0 | -4.0 | -5.5** | | |
| non-waxed can, tin top | 23% | 68 | 50 | -1.6 | -3.7 | | -5.7 | -10.0 | -13.0** | | |
| Hazel-Rutab basket, non-m. p. wrap | 23% | 68 | 50 | -4.9 | -10.0 | | -12.6 | -16.0 | -17.4** | | |
| waxed can, window top | 23% | 34 | 88 | .1 | .3 | | .5 | .8 | .8** | | |
| basket, non-m. p. wrap | 23% | 34 | 88 | 1.5 | 2.0 | | 3.1 | 3.5 | 3.8** | | |
| KHADRAWI Cured | | | | | | | | | | | |
| waxed can, window top | 15% | 68 | 50 | -.2 | -.4 | | -.6 | -1.6 | -2.5** | | |
| non-waxed can, tin top | 15% | 68 | 50 | -1.0 | -1.9 | | -3.3 | -6.7 | -7.9** | | |
| Manila bag | 15% | 68 | 50 | -5.5 | -6.4 | | -7.9 | -10.3 | -11.1** | | |
| waxed can, window top | 15% | 34 | 88 | .2 | .4* | | .6 | 1.1 | 1.2** | | |
| non-waxed can, tin top | 15% | 34 | 88 | .3 | 1.1* | | 2.1 | 3.5 | 3.8** | | |
| Manila bag | 15% | 34 | 88 | 1.3 | 3.8* | | 8.5 | 11.5 | 13.3** | | |
| BERHI Rutab | | | | | | | | | | | |
| waxed can, window top | 24% | 68 | 50 | -.5 | -1.3 | | -2.2 | -4.2 | -7.2** | | |
| | 24% | 34 | 88 | .4 | .5 | | .8 | 1.1 | 1.2** | | |
| | 24% | 5 | 85 | | | | | | .1** | | |

Note: *gain in 4 weeks time.
**5 month storage.

Dates pick up moisture at nearly a uniform rate per week, and cured fruit gains in weight faster than rutab or moist fruit, but equilibrium between moisture and sugar is not obtained until after a consistency is reached at which the dates are very perishable. In light-colored Deglet Noors this point is above 30 per cent moisture and in Khadrawis and Halawis it is above 20 per cent. Experiments now in progress indicate that a moisture content of the fruit needed to stop sugar deterioration is considerably lower than that needed to stop molding and souring of dates.

Moisture and weight change in dates is very slight at 5 deg. F. and considerably less at around 27 deg. than at 32 deg., therefore if dates are to be stored around the 32 deg. point, the temperature should be on the low side to get a slow moisture change.

Wax-lined fiber-board cans and moisture-proof transparent wraps are both effective in minimizing the absorption of moisture by the fruit in damp air and in preventing excessive loss of moisture in dry air.

The non-waxed fiber-board can is a good package for a two-week period in dry air, but such packages held three to four months in 32 deg. F. storage are apt to gain considerable moisture and cause deterioration of the fruit.

Dates in berry baskets with ordinary transparent wraps need a storage temperature of 27 deg. F. or below to prevent serious moisture absorption, and need quick consumption after storage to prevent serious drying.

No single type of package seems to be successful for all classes and types of dates unless freezer storage is used and quick consumption after storage is certain.

Moist, rutab dates should be packed in containers that allow drying after storage and need temperatures below freezing to retard deterioration in storage.

Cured dates can go into moisture-proof containers, but when moisture-proof material is used the packer needs to be sure that no rutab dates are mixed with the cured fruit, since the spoiling of one moist date may spoil the entire package.

The window package used is very attractive and quite moisture-proof due to the wax lining and material used for the window, but more drying occurs next the window than elsewhere throughout the package and the top layer of fruit may become drier than the rest if the package is held out of storage more than a few weeks. The window becomes billowy in damp air but will flatten out again in dry air without damage if it has been securely fastened to the lid.

I have purposely omitted discussing adhesives for sealing wrappers for date packages because there is a big need for a cheap, non-odorous, fast-sealing adhesive, especially for the basket packs that do not resist pressure.

# HOW CAN THE CALIFORNIA DATE INDUSTRY BE MADE SUCCESSFUL

## An Address Delivered by L. H. Davis, California Prune and Apricot Growers Assn., at the California Date Institute, Indio, April 21st

THE time has arrived when we must face facts and not be misled by those who would desire us to continue believing that theoretical methods are better than those proven successful by actual experience. Much has been written, and more has been spoken, during the past few years about steps which should be taken to put the California date industry on a basis which would be profitable to the producer. But, very little has actually been done toward correcting your troubles and putting the house in order, and why?

The answer is simple. During the growth of the California date industry, which has been increasingly rapid from year to year, more attention has been devoted to the planting of trees, selection of varieties, cultural problems, etc., than to the most vital of all needs — marketing. The result is that we now find ourselves producing several millions of pounds of dates annually and we cannot obtain a price for them which will return the producer a fair margin of profit on his investment and labor. Many of the spokesmen for the industry would like you to believe that all other agricultural industries are in the same predicament, and that the depression has caused all of the troubles within the industry. But, let us forget other enterprises for the moment and dwell upon the date industry and its problems, and then decide later as to which procedure to follow.

At this point, I wish to make it plainly understood, that I have no intention of criticising what has been done, or is being done within the California date industry towards improving conditions. But, in order to arrive at a point on which to begin our foundation, for future programs, certain references must be made to existing conditions.

First of all, the troubles within the date industry are not beyond repair. Nor is the cause of these troubles "cooperative marketing" vs. "commercial marketing." The basic trouble is due to the petty jealousy existing among certain groups and individuals, who seem to spend more time trying to protect their positions, than to correcting the problems confronting the growers.

Secondly, before any improvement within the California date industry can be brought about, the growers, individually and collectively, must solve their own problems by taking a personal interest in the problems confronting the industry and in the selection of those who are to be their spokesmen on vital matters. When such problems arise, secure the facts study them carefully, and then act.

What is most needed in the date industry today is stabilization. Many will say, "Well, that sounds very good, but how are we to have stabilization?" Others say, "It can't be done." But it can be done, and must be done, if the thousands of dollars invested within the industry are to be saved. And here, I think, is how.

Under the Agricultural Adjustment Act, all date growers can be placed under the provisions of the AAA; marketing agreements, with a bite in them, put into effect, and all this done through existing agencies within the industry, provided the majority of date growers demand it.

I shall explain the most important points which, in my opinion, should be applied to the industry, or rather the important points should be applied to the industry, or rather the important points which the Industry Code or marketing agreement should cover.

1. Establish grades and standards for all dates, which are to be sold to the consuming public. Under the Date Exchange these grades can be vigorously maintained. The number of grades offered to the trade should be reduced. They should be designated by some standard names such as Extra Fancy, Fancy, Extra Choice, etc.

2. Establish minimum prices on the packages in which dates are to be sold. A base price on bulk dates doesn't work out. If one concern can pack cheaper than another then give the additional profit to the growers. They can use it.

3. Regulate the number of packs that can be put out. Eight or ten ounce (not both); one pound: 15 pounds or 20 pounds (not both); and fancy packs in redwood, tin or baskets, which are not commercially competitive, generally speaking.

4. Establish certain trade practices, which would eliminate unethical deals, excessive allowances, rebates, etc.

5. License all packers or shippers of California dates, so that regulatory measures can be administered properly.

6. Continue, by all means, your California Date Exchange. It is, without a doubt, the greatest forward step you have taken in your industry in many years.

7. As far as possible utilize those methods of sales and distribution which have been set up through years of experiment for similar food products. Profit by the other man's experience.

8. Above all make it easy, for all the trade who are interested, to get California dates at competitive prices and terms.

9. Establish one general selling agency through the California Date Exchange.

Now let us review the advantage which will come to the date grower, if the industry is stabilized.

The establishment of standard grades for all agencies packing and marketing California dates, will eliminate the present confusion among the trade. It might surprise some of you growers to know that as the result of the many different packs of dates offered by the various shippers under different size and quality designations, so much confusion has arisen that it has caused a lack of interest in California dates among the distributing trade in our markets. We need all of the confidence and support which it is possible to obtain from the trade who can sell our dates down the line to the ultimate consumer.

The establishment of minimum prices at which all agencies would sell dates to the retailer with a suitable discount for jobbers, would do more to stabilize conditions within the industry than any other step. It would put all shippers on the same basis and ultimately result in a survival of the fittest, among the marketing agencies. If the selling price to the trade is the same by all shippers—the agency or agencies having the best selling line-up will obtain the preference — also the best managed organization will be the one which returns more to the grower because of economical operating cost.

Time and space are too limited to elaborate on and discuss the many other advantages which would come to the industry under stabilization. It is time to place the California date industry where it belongs and the Agricultural Adjustment Act is the long needed instrument to be used to accomplish this purpose. There is too large an investment in the date industry and too many people dependent upon date growing for a livelihood to permit the industry to go on in the present demoralized fashion.

Now, presuming that the above is acceptable to you and that you will put your own house in order, I want to tell you what I think it is necessary for you to do to move your present date crops and to prepare outlets for your increased future production.

Not one person out of a thousand in markets outside of California realizes that there are such things as California dates. You have to make the American consumer "date conscious" before you are going to get anywhere with your product. To do this you must advertise. But ordinarily, before you advertise you must have distribution or your advertising expenditure will be wasted. I believe I can explain to you some advertising which goes hand in hand with distribution. This I will discuss under separate headings as follows:

Demonstrators
Window Display
Advertising at the source of sale
Specialty Men.

**Demonstration**—In selecting stores for demonstration work, particular attention should be paid to the location of the store and to the consumers it serves. Take New York City for example. The quality trade in groceries does not lie in Manhattan or Brooklyn or the Bronx. It lies in the small neighboring towns and villages such as are located on Long Island, Westchester, Rye, and across the Hudson river in several small New Jersey towns. Each of these sections has many towns which boast of four or five high grade stores serving the cream of the consuming trade of the metropolitan area. These are the stores in which we must demonstrate, because we can thus reach the people who have the money to buy what they want in the way of good, clean foods and who would be steady customers for California dates once they got to know them. In those markets which are selected as being most suitable for increased sale of California dates I would do demonstration work in a selected list of fancier retail groceries and department stores. Attractive, intelligent young women should be used, preferably those experienced in talking to consumers and in selling edibles to the housewives. Such girls can be secured at a cost of three to four dollars a day—say $3.50 average. Samples to be given away would cost about $1.00 more. Therefore the demonstration work would cost around $5.00 per day per store. I would plan on having each demonstrator work four stores a week. Monday, Tuesday and Wednesday one store of the better class each day. Thursday, Friday and Saturday, the best shopping days, to be spent in one food market sufficiently large to insure a fresh supply of possible buyers every minute of the three days.

The demonstrator would be instructed to first, sample, all the clerks and sell them on California dates; the cooperation of the store's clerks will do more to put your product over than anything else; second, sample the telephone order takers so that they will sell California dates to their customers when taking orders over the telephone as so many of the better class grocers do; third, sample and sell consumers. A demonstrator's manual should be prepared instructing demonstrators to stress the cleanliness of our fruit, its wonderful flavor and health qualities, etc. Demonstrators would in all instances sell dates trying to sell in two pound units at a special price. If consumers wouldn't buy two

pounds they could buy one pound. But try to sell the larger unit.

In October, November and December, all of which months I would use for demonstrations, we have seventy business days. I would stop demonstrating on December 24th, or earlier if you could determine that the crop would all be sold. But figure 70 days at $5.00 a day is $350.00 for each demonstrator during which time she would work in about 45 stores contacting from 150 to 200 consumers per day and selling many of them. In this way one demonstrator would contact directly over 10,000 consumers giving them the story of your product by voice and, most important, by sight and taste. I would suggest selling only the second grade in bulk. Thus in a city like Chicago five demonstrators, in the months of October, November and December, would thoroughly sell the owner, manager, buyer, clerks and order takers in 225 stores supplying permanent retail outlets for California dates, and most important they would render 'California Date Conscious" over 50,000 consumers. And all at a cost of about $1750.00 — $2,000.00 at the most. A cost of 4 cents per contact, many of which will be sales.

To supplement the work of the demonstrators I would have a small attractive folder printed giving the romantic story of California dates, together with recipes for their use. Each person contacted would receive one whether she purchased or not, and if she didn't learn anything else on her visit to the store she would leave knowing the story of California dates.

For the first year I would use not over 25 demonstrators in selected Eastern markets with possibly two more in the Pacific Northwest at a total cost of not over $9,000.00, selling thoroughly 1225 retailers and over 200,000 consumers.

These demonstrators would be aided by specialty men as I will later outline.

**Window Displays**—There is nothing that sells a tempting product such as California dates so well as the fruit itself. Therefore, my central idea in a window display would be the dates themselves—a lot of them—a whole window full if possible. Now to dress up the window I suggest a "velvetone" or "polychrome" back display—a scene showing the date palms with the dates hanging on them—a background of your mountains and desert with their vivid colors. Then on the sides, two or four bunches of dates so people can see how they grow, together with five or six palm leaves giving a sort of a roof or bower effect. The only other printing I would have would be price card banners one on each side of the window and a center card right down in the dates describing their cleanliness, healthfulness and deliciousness.

It would cost about two dollars each for the background, another two dollars for the date bunches, leaves and boxes for shipping and freight on same, another one dollar and a half or two dollars for an expert window display man to set up and take down the display. A total of six dollars for the display. They could be used twice but on the second set up I would advise letting smaller retailers and chain stores use them and set up their own displays.

**Advertising at the Source of Sale**—In my opinion the most effective food advertising for California dates now, is that which appears right in the copy of the chain or retail store advertisement. When a housewife reads a chain store ad she is looking for something to buy—something to eat—something at a bargain price. And when a chain runs an advertisement on some item it is usually at a special price. Such advertising does two things. First, it compels the chain to have California dates in stock in all of its stores; second, it gets the dates to the consumer at a minimum mark up in price and rapidly widens distribution for us.

The cost of such advertising is nominal. You pay for what you get —no premium to the chain. You help your brokers or salesmen to move the dates. You get prominent display space for your dates because all advertised items are featured in the stores. What cheaper advertising can you buy?

I am not at all in favor of national advertising on California dates at the present time. You do not have distribution sufficient to justify it and, it is, in my opinion, a waste of money which could be used much more profitably elsewhere. National advertising will fit into your merchandising plan only when you have real national distribution and that time is still a few years distant.

**Specialty Men**—Specialty men should be used for three purposes. First, to sell dates to the retailer; second, to arrange time for a demonstrator, and third, to secure space for a window display. They would also help out on demonstrations on Saturdays on which days they cannot call on retailers. You would need about eleven men for three months at a cost of about $5,500.00.

Specialty men should take orders through any jobber or wholesaler. They'll all stock California dates if their retailers want them. Show the jobbers the sales and they'll not only fill your specialty orders but will soon have their own men working on California dates.

**By-products** — It will undoubtedly be of interest to you to know that we are meeting with considerable success in developing a market among manufacturers for California dry dates—No. 2 drys to be exact. Our experience thus far leads us to believe that sufficient volume can be developed in manufacturing channels to use every year all the cull dates you produce and thus obviate any chance of these culls or drys interfering with the sale of natural dates or causing a lowering in the market price of natural dates.

California dates, pitted or ground, although higher in price than imported pitted dates, have several advantages over the imported date from a manufacturer's standpoint. They are clean and of exceptionally good flavor. But most important—they are uniform in moisture content and their dryness gives the manufacturer a gain in weight when he adds moisture to them. This lowers his cost to a point somewhere near the price of imported dates and gives him a dependable product.

Then, too, the name "California" on the package he puts out gives his article a prestige, a class, which would not be gained otherwise.

Here I wish to state that in my opinion the California date industry will be on a much firmer foundation when we interest regular grocery jobbers to a much greater extent in California dates. Not that produce dealers generally are not a good outlet but their method of sale and distribution does not give us completely what we need. If we can get only a small part of the jobber's salesmen in this country to sell California dates a large share of our merchandising problem will be over. A retailer should be able to buy our dates whenever and wherever he wants to buy them and not have to call at any one particular distributor's place of business when possibly the only business he does with that distributor is dates. One or two distributors to a market are not sufficient for our purpose. You have to

make it easy and convenient for all retailers to buy your dates.

To sum up, the final costs would be—

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| Demonstrations - - - | $9,000 |
| 1,000 window displays set-up | 6,000 |
| Specialty men - - - - | 5,500 |
| Miscellaneous costs - - - | 1,000 |
| | $21,500 |
| Direct chain advertising - | 10,000 |
| | $31,500 |

A cost of 1 cent per pound on 3,150,000 pounds of dates.

This advertising, if carried through to a successful conclusion, doesn't have to cost you one cent. The consumers pay it the same as they do in every other line of business. You listen to Amos and Andy, I imagine, but do you think that the Pepsodent people pay for that broadcast out of their treasury? Not at all. That entertainment, together with the story about their product is paid for by any of us who use Pepsodent products. So can it be done with dates. If a price of 20c a pound is satisfactory to you for the P. grade, let's add 1c for promotional work making a selling price of 21c. With this demonstrating, window displays, advertising and specialty work you have more chance of getting the 21c than you have of getting 20c without it.

And what of the crops to come? Growers down here tell me that a ten million pound crop is not out of the question in a few years. Don't you think it is about time for you to be doing something about widening your markets so that this increased tonnage will be absorbed without seriously lowering prices? You can't wait until the big crop is upon us. You've got to build up your markets and the time to start is now.

I am not going to take up any more of your time now in further detailed discussion of my ideas of what is necessary for the California date industry to do to establish its fruits in the markets of the United States. But I would like the opportunity of going into this general merchandising picture, its needs and requirements, in detail, with the Board of the California Date Exchange in the near future. Time is important in this picture and if anything is to be done plans should be made soon. It is easy enough to make plans of this kind but carrying them through to a successful conclusion is something else. It's up to you people to decide whether or not you are all willing to cooperate in a general sales plan for your mutual benefit. California dates can be sold at a profitable price. People like them. That has been demonstrated. The means and opportunity of selling your crop is at hand.

# SUBJECT INDEX
## for
# ANNUAL DATE GROWERS INSTITUTE PROCEEDINGS
## Numbers 1-10 inclusive

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